



Ask Dr. ALOHA: An Input Sensitivity Quiz

Every experienced user of ALOHA knows that you usually have to guesstimate some of the information you enter into it as you set up scenarios. Perhaps you have to guess at the wind speed, or you can't safely get close enough to a

container to check the tank temperature or measure the size of a hole.

ALOHA itself incorporates aids to help you choose some inputs when you're not sure. For example, you can select the "Wind speed estimate" help topic to check a table of the wind speeds that correspond to various environmental cues, such as rustling leaves (about 4 to 6 knots) or swaying trees (17 to 21 knots).

But sometimes you may know only an approximate range within which an input value falls. For example, you may be pretty sure that the wind speed is somewhere between 5 and 8 miles per hour. To be able to err on the side of caution, you then may want to know which values within that range are more or less **conservative**. A value for an ALOHA input is conservative if, by using it, you're more likely to overestimate than underestimate the size of the footprint or the concentration of a toxic gas at a location of concern.

Here's a short quiz to help you sharpen your skills at identifying conservative input values. The best way to answer these questions is to experiment with ALOHA to see how changing input values affects its predictions.

Questions

1. You're an environmental consultant, and you've taken a short-term job in Senegal, West Africa. Right now, you're running some ALOHA scenarios in order to evaluate the potential hazard to several villages from a proposed fertilizer manufacturing plant. The countryside around the plant site is mostly peanut fields, but you also see many baobab trees interspersed among the rows of peanuts. For purposes of choosing a ground roughness value, it seems equally reasonable to class the area as "Open Country" or "Urban or Forest." If you wanted to be conservative in your choice, which of these two options should you choose? (Hint: to get an idea of the answer, run an ALOHA scenario with "Open Country" selected as your ground roughness choice. Then, run the same scenario again, this time changing to "Urban or Forest" roughness, and watch to see how the size of the footprint changes. To choose a ground roughness value, from the **SetUp** menu, choose **Atmospheric**, and then **User Input**. Just below the "Ground roughness is:" heading, click either "Open Country" or "Urban or Forest.")

2. You're in Washington, DC, helping the National Research Council prepare recommendations for Levels of Concern to use in ALOHA and other air

models. Two different toxicology labs have each proposed a new exposure guideline that air modelers could use as a Level of Concern. Each lab has proposed values for their guideline for some common hazardous chemicals. Although the two guidelines are intended to represent the same level of hazard, the values set by Lab A tend to be smaller than Lab B's values. For example, Lab A's value for ammonia is 5 ppm, while Lab B's value is 10 ppm. You feel that if all else is equal, the Council should recommend the most conservative guideline as a Level of Concern for air modeling. Which of the guidelines is most conservative: Lab A's guideline, which tends to be smaller, or Lab B's guideline, which tends to be larger? (Hint: Run an ALOHA scenario. Next, from the **Display** menu, choose **Options**. Type Lab A's value into the Level of Concern box, and make sure that "ppm" is selected as the units. Click **OK**, then have ALOHA display a footprint, and check the size of the footprint. Next, try this with Lab B's value, and see how the size of the footprint changes.

3. You're the administrator of a hospital in southern California. During a training course, you're learning the basics of air modeling and running some practice scenarios in ALOHA. You would like to know how a chlorine release from a water treatment plant near your hospital might affect people inside your hospital. To find that out, you decide to run a scenario and check indoor concentration at your hospital's location. As you work with the Building Type menu, you decide that of the available choices, "Enclosed office building" best describes your hospital. Now you need to enter a value for the number of air changes per hour within the hospital. ALOHA's online help tells you that you can use a number anywhere between 0.01 and 60 changes per hour. Would it be more conservative to use a larger number of changes per hour or a smaller number? (Hint: to find out, set up an ALOHA scenario, then try different values for the number of air changes per hour, watching to see how changing this value changes the size of the footprint. To adjust air changes per hour, from the **SiteData** menu, choose **Building Type**, click **Enclosed office building**, then type in your value for air changes.)

Infiltration Building Parameters

Select building type or enter exchange parameter

☒ Enclosed office building Help

☐ Single storied building

☐ Double storied building

☐ No. of air changes is per hour

OK Cancel

4. You're a Coast Guard officer, and you need to draw up a plan for safely removing some old, corroded ammonia cylinders from the deck of an abandoned fishing vessel, which grounded on a reef just off Pago Pago 4 years ago. If any of the cylinders were to rupture while being moved, the prevailing winds could blow the ammonia gas towards several seaside villages. You know that the wind speed in the area typically ranges between 3 and 8 knots. You would like to use ALOHA to find out what the worst-case accident might be. You decide to model an accidental release of the entire contents of one of the cylinders. Now you need to choose a wind speed. You'd like to use the most conservative value between 3 and 8 knots. What would that value be? (Hint: To find out, run an ALOHA scenario, then try some different values for wind speed, watching to see the effect on footprint size. To adjust wind speed, from the **SetUp** menu, choose **Atmospheric**, then **User Input**, and then type in a wind speed value.)

5. When you used older versions of ALOHA, you had to choose atmospheric stability class yourself. The current version uses your choice of location and your values for date and time, wind speed, and cloud cover to choose a stability class for you. In some cases, more than one stability class would be appropriate for a given set of conditions. For example, when it's sunny and the wind speed is between 4.5 and 6.7 miles per hour, either A or B stability is appropriate. However, ALOHA always selects just one of the possible alternatives for you (you then can choose either to accept its choice or to select a different stability class). Does it always make the most conservative choice? (Hint: read the "Stability class" and "Overriding the stability class table" help topics.)

6. You are the chief engineer at the Great Plains Fertilizer plant, and you are trying to comply with the Risk Management Planning provisions of the Clean Air Act. To do this, you're performing offsite consequence analyses for ammonia, which you store and use at your plant. You are using ALOHA to see which kinds of release scenarios would pose the greatest hazard to people living near your plant. You have chosen ALOHA's Direct Source option, and now you need to enter the release rate and duration. You know that increasing the release rate would result in a larger ALOHA footprint. But you aren't so sure about the effect of changing duration. Would a shorter or longer duration be most conservative, or does it even matter? (Hint: to experiment with release duration, from the **SetUp** menu, choose **Source**, then choose **Direct**. Click **Continuous source**, then type in the amount of chemical being released and the duration of the release, which can be between 1 and 60 minutes. Leaving the amount unchanged, try adjusting duration. Watch for two possible effects of your adjustments: (1) change in footprint length and (2) change in the Concentration by Time graph. To view this graph, double-click within the footprint to select a location. ALOHA will display a graph showing

predicted indoor and outdoor concentrations at that location for the hour following the start of the release.)

User Input Source Strength				
Select source strength units of mass or volume:			Help	
<input type="radio"/> grams	<input type="radio"/> kilograms	<input checked="" type="radio"/> pounds	<input type="radio"/> tons(2,000 lbs)	
<input type="radio"/> cubic meters	<input type="radio"/> liters	<input type="radio"/> cubic feet	<input type="radio"/> gallons	
Select an instantaneous or continuous source:			Help	
<input checked="" type="radio"/> Continuous source		<input type="radio"/> Instantaneous source		
Enter the amount of pollutant ENTERING THE ATMOSPHERE:			Help	
<input type="text" value="50"/>	<input type="radio"/> pounds/sec	for <input type="text"/>	minutes (1-60)	
	<input checked="" type="radio"/> pounds/min			
	<input type="radio"/> pounds/hr			
Enter source height (0 if ground source):		<input type="text" value="0"/>	<input checked="" type="radio"/> feet	Help
			<input type="radio"/> meters	
OK		Cancel		

Answers

1. "Open Country" is the most conservative choice. When all else is equal, a footprint will be longest when you choose a smaller ground roughness value, and "Open Country" represents a smaller roughness value than "Urban or Forest." How does ground roughness affect gas dispersion? Friction between the ground and air passing over it generates atmospheric turbulence. The rougher the ground surface, the greater the ground roughness, and the greater the turbulence that develops. The greater the turbulence, the faster a toxic cloud is diluted to below your level of concern, and the smaller is ALOHA's footprint. (Of course, the value that you choose for a scenario should be the one that best represents the actual average ground roughness of the area downwind of a release.)

2. Lab A's guideline is the most conservative choice. ALOHA's footprint encompasses the area in which ground-level chemical concentrations are predicted to exceed your Level of Concern. The lower the Level of Concern, the larger the area in which it may be exceeded.

3. The answer to this question depends somewhat on the circumstances of the release. Most often, a larger number of air changes per hour is likely to be more conservative. This is because the faster the air exchange rate for a building, the more rapidly a pollutant gas infiltrates into the building, and the higher is the concentration of the gas to which people within the building are exposed. However, particularly in cases when the Level of Concern for a chemical is low and the release continues for a long time, a smaller number

of air changes per hour can be more conservative, since the lower the air exchange rate, the longer the toxic gas remains in the building, even though it will build up more slowly and reach lower concentrations.

4. The lower wind speed of 3 knots is the most conservative choice. It may seem that an ALOHA footprint would be longest when the wind is strongest. But the opposite is true. When the wind blows more strongly, the gas cloud is spread out and diluted faster, so that the area where chemical concentrations exceed your Level of Concern is smaller. When all else is equal, lowering wind speed will increase footprint length for a given ALOHA scenario.

5. Yes, ALOHA always chooses the most conservative of the possible stability classes for you. This is always the most stable class. When the atmosphere is more stable, the atmosphere is least turbulent, so that a gas cloud, as it spreads out and moves downwind, would be diluted more slowly to below your Level of Concern. As a result, ALOHA's footprint would be larger. ALOHA uses six stability classes: A, B, C, D, E, and F. Among these classes, A is the least stable (least conservative), and F is the most stable (most conservative).

6. A longer duration is more conservative. Increasing release duration for a Direct release can enlarge the footprint if the initial duration is relatively brief. In other cases, changing duration won't affect the footprint. However, increasing duration increases the length of time that the Level of Concern is predicted to be exceeded (adjust release duration, then check ALOHA's Concentration by Time graph to see this effect). Generally, the longer people are in contact with a hazardous gas, the more seriously they are affected.

<p>News Flash: If you have access to the Internet, you now can view or print out past Ask Dr. ALOHA columns. You'll find them, along with other aids for ALOHA users, in the "CAMEO Toolkit" at http://www-orca.nos.noaa.gov/projects/hazmat/cameo/toolkit.html. Click the "Answers to Your ALOHA Questions" link to enter the new Ask Dr. ALOHA archive.</p>
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